WHAT IS CLAIMED:

1. A three-dimensional imaging system, comprising:

a three-dimensional display;

an image scanning device for capturing a three-dimensional image to be displayed on said three-dimensional display; and

three-dimensional calibration equipment for calibrating said image scanning device,

wherein both said three-dimensional display and said image scanning device employ optical pulses and non-linear optics to display and record, respectively, a three-dimensional image.

2. The three-dimensional imaging system of Claim 1, wherein said image scanning device is a three-dimensional optical recorder.

3. The three-dimensional imaging system of Claim 1, wherein said image scanning device is a two-dimensional optical recorder.

4. The three-dimensional imaging system of Claim 3, wherein said two-dimensional imaging system includes at least one two-dimensional optical recorder.

5. A three-dimensional display, comprising:

at least three pulsed optical sources; and

an optical mixer movable in a display space,

wherein said at least three pulsed optical sources are spatially separated so as to permit pulses emanating therefrom to overlap in a voxel within said display space and intersecting said optical mixer at a selected position, whereby a first-order non-linear interaction of said pulses causes said optical mixer to produce at least one pre-determined wavelength of electromagnetic waves.

6. The three-dimensional display of Claim 5, wherein said optical mixer includes a plurality of non-linear mixer elements.

7. The three-dimensional display of Claim 5, wherein said pulses emanating from said at least three pulsed optical sources are ultra short optical pulses.

8. The three-dimensional display of Claim 5, wherein said ultra short optical pulses have a pulse width in the range of femtoseconds to nanoseconds.

9. The three-dimensional display of Claim 5, further comprising at least one optical filter adapted to permit the passage of said at least one pre-determined wavelength.

10. (Cancelled)

11. The three-dimensional display of Claim 6, wherein said optical mixer recurrently sweeps through every voxel in said display space.

12. The three-dimensional display of Claim 11, wherein said optical mixer is planar in shape.

13. The three-dimensional display of Claim 12, wherein said optical mixer moves periodically back and forth in a direction normal to the plane of said optical mixer.

14. The three-dimensional display of Claim 11, wherein said optical mixer rotates about an axis.

15. The three-dimensional display of Claim 11, further comprising display electronics.

16. The three-dimensional display of Claim 11 or Claim 14, wherein said optical mixer is of a shape such that said optical mixer is capable of producing desired wavelengths in each voxel of said display space and a mapping of said shape is known to display electronics.

17. The three-dimensional display of Claim 16, wherein said display electronics selects combinations of said at least three pulsed optical sources to produce desired wavelengths at desired voxels and stores alternative possible combinations of said at least three pulsed optical sources as lists of predetermined pulsed optical source combinations, wherein said predetermined lists of alternative possible combinations of pulsed optical sources equalize the peak intensity of the desired wavelengths produced from said combinations of said at least three pulsed optical sources, and wherein said display electronics allows for the simultaneous excitement of voxels in said display space.

18. The three-dimensional display of Claim 6, wherein a subset of said at least three pulsed optical sources operate so as to excite said optical mixer in a plurality of voxels with a predetermined combination of optical frequencies so as to produce a plurality of desired wavelengths in a time interval that is much less than the repetition rate of movement of said optical mixer so that persistence of vision of the viewer makes the illumination of said voxels appear to be simultaneous.

19. The three-dimensional display of Claim 18, wherein different subsets of said at least three pulsed optical sources are chosen for different voxels and different positions of said optical mixer so as to maintain an approximately constant conversion efficiency.

20. The three-dimensional display of Claim 18, wherein each of said plurality of non-linear mixer elements has a cone of acceptance which is used to select the different subsets of said at least three pulsed optical sources for different voxels and different positions of said optical mixer.

21. The three-dimensional display of Claim 18, wherein said at least three_pulsed optical sources operate so as to excite said optical mixer in said plurality of voxels to produce said desired wavelengths.

22. The three-dimensional display of Claim 18, wherein one of said at least three optical sources emits a pulse of a pre-selected intensity and pulse width so as to control the brightness of the light produced in said plurality of voxels.

23. The three-dimensional display of Claim 18, wherein one of said at least three pulsed optical sources emits pulses having durations longer than durations of pulses emitted by the remaining pulsed optical sources.

24. The three-dimensional display of Claim 5, wherein each of said at least three pulsed optical sources includes a wavelength generator and a lens for focusing a wavelength of light.

25. The three-dimensional display of Claim 24, wherein said wavelength generator is a point source of light and is located at the focal point of said lens.

26. The three-dimensional display of Claim 5, wherein each of said at least three pulsed optical sources includes a wavelength generator, an optical splitter for dividing an optical pulse emitted by said

wavelength generator into multiple optical pulses, and a pulse controller for independently delaying and attenuating each of said multiple optical pulses.

27. The three-dimensional display of Claim 5, wherein said optical mixer moves periodically at a rate of repetition of at least twenty frames per second.

28. The three-dimensional display of Claim 6, wherein said plurality of non-linear mixer elements is composed from a non-linear optical material chosen from the group consisting of $LiNbO_3$, $LiIO_3$, KH_2PO_4, Tl_3AsSe_3 (TAS), Hg_2Cl_2, KH_2PO_4 (KDP), KD_2PO_4 (DKDP or D*KDP), $NH_4H_2PO_4$ (ADP), Hg_2Br_2 and $BaTiO_3$, quantum well structure semiconductors made of GaAs, etc.; organic single crystals made of 4-nitrobenzylidene-3-acetamino-4-methoxyaniline (MNBA), organic single crystals made of 2-methyl-4-nitroaniline (MNA); conjugated organic high molecular compounds made of polydiacetylene, conjugated organic high molecular compounds made of polyarylene vinylene, semiconductor grain-dispersed glass comprising CdS dispersed in glass, and semiconductor grain-dispersed glass comprising CdSSe dispersed in glass.

29-37. (Cancelled)

38. A three-dimensional image scanner for capturing a three-dimensional image of an object, comprising:

a first pulsed optical source for generating an illuminating optical pulse at an illumination wavelength, said first pulsed optical source directing said illuminating optical pulse toward the object;

a second pulsed optical source for generating a gating optical pulse at a gating wavelength having a controlled time delay relative to said first pulsed optical source;

an optical mixer positioned to receive light reflected from the object at a single wavelength in response to interaction of said illuminating optical pulse with the object, a portion of said illuminating optical pulse and a portion of said gating optical pulse spatially and temporally overlapping each other within the optical mixer, thereby producing a first optical mixer generated pulse indicative of the shape of the object; and

an optical recorder having a plurality of pixels for capturing light emitted by said optical mixer and for capturing light reflected from the object.

39. The three-dimensional image scanner of Claim 38, further comprising display electronics for controlling the relative timing of said first pulsed optical source and said second pulsed optical source.

40. (Cancelled)

41. (Cancelled)

42. The three-dimensional image scanner of Claim 38, wherein each of said plurality of pixels of said optical recorder has a planar shape.

43. (Cancelled)

44. The three-dimensional display of Claim 38, wherein said ultra short optical pulses have a pulse width in the range of femtoseconds to nanoseconds.

45. The three-dimensional display of Claim 6, wherein each of said plurality of non-linear mixer elements is composed from a non-linear optical material chosen from the group consisting of $LiNbO_3$, $LiIO_3$,

KH_2PO_4, Tl_3AsSe_3 (TAS), Hg_2Cl_2, KH_2PO_4 (KDP), KD_2PO_4 (DKDP or D*KDP), $NH_4H_2PO_4$ (ADP), Hg_2Br_2 and $BaTiO_3$, quantum well structure semiconductors made of GaAs, etc.; organic single crystals made of 4-nitrobenzylidene-3-acetamino-4-methoxyaniline (MNBA), organic single crystals made of 2-methyl-4-nitroaniline (MNA); conjugated organic high molecular compounds made of polydiacetylene, conjugated organic high molecular compounds made of polyarylene vinylene, semiconductor grain-dispersed glass comprising CdS dispersed in glass, and semiconductor grain-dispersed glass comprising CdSSe dispersed in glass.

46. A method for calibrating a three-dimensional imaging system having optical apparatus for capturing an optical image of a desired object from at least two positions, comprising the steps of:

projecting a virtual calibration pattern in the field of view of the optical apparatus;

choosing one position of the optical apparatus as a reference position;

assigning coordinates of a coordinate system relative to either the virtual calibration pattern or the reference position;

measuring the differences in the virtual calibration pattern from a second position of the optical apparatus;

calculating calibration corrections relative to the reference position based on the spatial locations and orientations in the reference position and the second position; and

adjusting images from the optical apparatus based on the calibration corrections.

47. The method of Claim 46 further including the step of assigning the coordinate system at the second position.

48. The method of Claim 47, wherein the optical apparatus includes a single optical recorder that moves between a reference and a displaced position.

49. The method of Claim 48, wherein said single optical recorder is a three-dimensional camera.

50. The method of Claim 48, wherein said single optical recorder is a two-dimensional camera.

51. The method of Claim 48, wherein said single optical recorder includes an electronic imaging detector comprising a pixel array and said step of assigning coordinates is either in parallel to the pixel array or normal to the pixel array.

52. The method of Claim 47, wherein the optical apparatus includes at least two optical recorders, one of which is located at a reference position and another of which is located at a displaced position.

53. The method of Claim 52, wherein said at least two optical recorders are three-dimensional cameras.

54. The method of Claim 52, wherein said at least two optical recorders are two-dimensional cameras.

55. The method of Claim 52, wherein said at least two optical recorders include an electronic imaging detector comprising a pixel array and said step of assigning coordinates is either in parallel to the pixel array or normal to the pixel array.

56. The method of Claim 47, wherein said step of assigning coordinates is in alignment with the virtual calibration pattern.

57. The method of Claim 47, wherein the coordinates are assigned arbitrarily.

58. The method of Claim 47, wherein said compensating step is performed mechanically or electronically.

59. A method of calibrating an optical recorder of a three-dimensional imaging system, comprising the steps of:

projecting a calibration pattern at a calibration wavelength on a plane that is tangent to the nearest point of a desired object as measured from the optical recorder;

labeling an intersection point P between said calibration pattern and the desired object;

positioning a laser light beam operating at said calibration wavelength at the point P;

measuring the distance from the point P to said calibration pattern;

generating a second calibration pattern at a greater distance from the optical recorder; and

repeating said steps of labeling, positioning, and measuring when said second calibration pattern intersects the desired object.

60. The method of Claim 59, wherein the intersection of said calibration pattern with the desired object includes a plurality of intersection points, said method further comprising the steps of:

labeling a subset of said plurality of intersection points in numerical order starting with a first point and continuing to a last point; and

repeating said steps of positioning and measuring starting with the first point and continuing through the subset to the last point.

61. The method of Claim 59, further comprising the steps of:

generating a second calibration pattern at a greater distance from the optical recorder; and

repeating said steps of labeling, positioning, and measuring when said calibration pattern intersects the desired object.

62. A method of calibrating a three-dimensional imaging system relative to a desired object to be imaged, the three-dimensional imaging system including at least two optical recorders to be calibrated and holographic calibration plates placed in fields of view of the at least two optical recorders, wherein the holographic calibration plates contain a common holographic calibration pattern, the method comprising the steps of:

positioning the holographic calibration plates relative to each other to approximate a monolithic calibration plate;

projecting the common holographic calibration pattern into fields of view of the at least two optical recorders, wherein said fields of view_include the desired object and at least three reference points whose positions relative to each of the at least two optical recorders is known;

determining a corresponding position on the common holographic calibration pattern corresponding to each reference point;

determining the misalignment of the common holographic calibration pattern;

determining the correction factors as a function of position of the desired object relative to each of the at least two optical recorders; and

applying the correction factors to each of the at least two optical recorders.

63. The method of Claim 62, wherein said correction factors include shift, rotation and scaling in an orthogonal coordinate system as a function of position of the desired object in three-dimensional space.

64. An apparatus for calibrating a three-dimensional imaging system relative to a desired object illuminated by desired wavelengths, comprising:

acquiring means for acquiring an optical image of the desired object from at least two positions;

a holographic calibration plate placed between said acquiring means and the desired object; and

a light source of at least one of a set of calibration wavelengths for illuminating said holographic calibration plate so as to project at least one virtual calibration pattern in the field of view of said acquiring means and proximal to the desired object.

65. The apparatus of Claim 64, wherein said acquiring means is a single optical recorder that moves between a reference position and a displaced position.

66. The apparatus of Claim 65, wherein said single optical recorder is a three-dimensional camera.

67. The apparatus of Claim 65, wherein said single optical recorder is a two-dimensional camera.

68. The apparatus of Claim 64, wherein said acquiring means is at least two optical recorders, one of which is located at a reference position and another of which is located at a displaced position.

69. The apparatus of Claim 68, wherein said at least two optical recorders are three-dimensional cameras.

70. The apparatus of Claim 68, wherein said at least two optical recorders are two-dimensional cameras.

71. The apparatus of Claim 64, wherein said light source is placed on the side of said holographic calibration plate that contains the desired object.

72. The apparatus of Claim 64, wherein said light source is placed on the side of said holographic calibration plate that contains said acquiring means.

73. The apparatus of Claim 64, wherein said virtual holographic calibration pattern includes a multidimensional wireframe.

74. The apparatus of Claim 64, wherein said virtual holographic calibration pattern has a three dimensional shape.

75. The apparatus of Claim 73, wherein said multidimensional wireframe has an arbitrary shape and includes intersecting locations.

76. The apparatus of Claim 75, wherein said intersecting locations are labeled.

77. The apparatus of Claim 76, wherein said intersecting locations are labeled with numerals.

78. The apparatus of Claim 64, wherein said holographic calibration plate has multiple, superimposed holograms recorded at different calibration wavelengths.

79. The apparatus of Claim 64, wherein said holographic calibration plate has multiple holograms recorded at different calibration wavelengths and at different positions on said holographic calibration plate.

80. The apparatus of Claim 75, wherein illumination of said holographic calibration plate with different calibration wavelengths produces

virtual calibration objects comprising multidimensional wireframes of arbitrary shape of varying levels of detail and displacement.

81. The apparatus of Claim 64, further comprising a mirror that is reflective to said calibration wavelengths but is transparent to said desired wavelengths, said mirror being placed in the field of view of said acquiring means.

82. The apparatus of Claim 64, wherein the desired object reflects the desired wavelengths, which are optically separable from said calibration wavelengths.

83. The method of Claim 62, wherein said step of applying correction factors is performed mechanically.

84. The apparatus of Claim 64, further including wavelength selection means for separating the desired wavelengths from said calibration wavelengths; calibration electronics for processing said calibration wavelengths and the desired wavelengths; a first memory for storing data related to said calibration wavelengths; and a second memory for storing data related to the desired wavelengths.

85. The apparatus of Claim 84, wherein said wavelength selection means includes wavelength selection filters to split color and spatial wavelengths to separate CCD arrays.

86. The apparatus of Claim 84, wherein said calibration electronics includes a band pass filter and a band stop filter.

87. The apparatus of Claim 64, further comprising a shutter interposed between said acquiring means and the desired object, said shutter being operable to produce an image of the desired object from said calibration wavelengths for at least one frame and an image of the

desired object from the desired wavelengths for at least one other frame.

88. The apparatus of Claim 64, further comprising a material that is reflective of at least one of said calibration wavelengths and that may be applied to the desired object at predetermined points.

89. The apparatus of Claim 64, further comprising a laser pointer which illuminates a point on the desired object with one of said calibration wavelengths.

90. The apparatus of Claim 64, further comprising a laser ranging calibration device which illuminates a point on the desired object with one of said calibration wavelengths.

91. The apparatus of Claim 64, wherein said holographic calibration plate includes a plurality of holographic calibration plates, each of said plurality of holographic calibration plates containing the same recorded hologram.

92. The apparatus of Claim 64, wherein said field of view of said acquiring means includes at least three reference points that are illuminated at said calibration wavelengths.

93. The apparatus of Claim 92, further comprising a beam of light that illuminates said at least three reference points with said calibration wavelengths.

94. The apparatus of Claim 64, further comprising a band stop filter located between the desired object and said holographic calibration plate for preventing an illuminating wavelength from a hologram source from traveling to the vicinity of the desired object.

95. The apparatus of Claim 64, further comprising a stereoscopic microscope placed between the desired object and said holographic calibration plate.

96. The apparatus of Claim 64, further comprising a plate on which is imprinted a desired object to be identified.

97. (Cancelled)

98. The three-dimensional image scanner of Claim 38, wherein each of said plurality of pixels further includes a first portion having an associated filter which passes only optical mixer-generated pulses.

99. The three-dimensional image scanner of Claim 38, wherein each of said plurality of pixels further includes a second unfiltered portion which passes light reflected from the object.

100. The three-dimensional image scanner of Claim 38, wherein each of said plurality of pixels further includes a second portion having an associated filter which passes only colors reflected from the object.

101. The three-dimensional image scanner of Claim 100, wherein said associated filter is formed by a coating on said second portion of said plurality of pixels.

102. The three-dimensional image scanner of Claim 98, wherein said optical mixer includes a plurality of non-linear mixing elements, each of which is placed proximal to a corresponding one of said plurality of pixels.

103. The method of Claim 62, wherein said step of applying correction factors is performed electronically.

104. The apparatus of Claim 66, further comprising an optical shutter for blocking the desired wavelengths from entering the optical recorder during selected calibration intervals.

105. The apparatus of Claim 67, further comprising an optical shutter for blocking the desired wavelengths from entering the optical recorders during selected calibration intervals.

106. The apparatus of Claim 69, further comprising a mechanical shutter for blocking the desired wavelengths from entering the optical recorder during selected calibration intervals.

107. The apparatus of Claim 70, further comprising a mechanical shutter for blocking the desired wavelengths from entering the optical recorders during selected calibration intervals.

108. A method of rendering a three-dimensional image, comprising the steps of:

capturing a plurality of multi-dimensional images of a desired object from at least one multi-dimensional optical recorder such that each of the plurality of multi-dimensional images is captured from a different spatial orientation relative to the desired object,

using holographic calibration to combine the plurality of multi-dimensional images into a three-dimensional representation of the desired object;

sending the three-dimensional representation to a display; and

displaying a three-dimensional image of the desired object on the display by generating pulses from a plurality of ultra short optical pulse generators and controlling the pulse times of said

pulses, such that said pulses coincide at voxels in a display volume when non-linear mixer elements occupy the voxels.

109. The method of Claim 108, wherein said step of capturing a plurality of multi-dimensional images further includes the step of capturing a plurality of two-dimensional images using at least one two-dimensional optical recorder.

110. The method of Claim 108, wherein said step of capturing a plurality of multi-dimensional images further includes a plurality of three-dimensional images using said at least one three-dimensional optical recorder.

111. The method of Claim 108, wherein said step of capturing the plurality of multi-dimensional images further includes the step of capturing two-dimensional and three-dimensional images using a combination of two-dimensional and three dimensional optical recorders.

112. The method of Claim 109, wherein the at least one two-dimensional optical recorder captures color, texture, and shading data.

113. The method of Claim 108, wherein said step of sending the three-dimensional representation to a display further includes the step of sending the shape, color, texture, and shading data to the display.

114. The method of Claim 113, wherein said step of displaying further includes the step of utilizing the shape, color, texture, and shading data to control the pulse time of combinations of a plurality of ultra short optical pulse generators.

115. The method of Claim 108, wherein said step of using holographic

calibration further includes the step of utilizing at least one holographic plate containing a common holographic calibration pattern to combine the two-dimensional images from the one two-dimensional optical recorder into the three-dimensional representation of the desired object.

116. The three-dimensional display of Claim 108, wherein said optical mixer includes a plurality of non-linear mixer elements.

117. The three-dimensional display of Claim 6 or Claim 116, wherein each of said plurality of non-linear mixer elements further includes at least three sub-elements, each including a non-linear optical material.

118. The three-dimensional display of Claim 117, wherein each of said sub-elements is optimized to produce a desired optical wavelength.

119. The three-dimensional display of Claim 118, wherein said sub-elements are arranged such that no two types of sub-elements optimized for the same desired wavelength are adjacent to one another.

120. The three-dimensional display of Claim 6 or Claim 117, wherein each of said plurality of non-linear mixer elements further includes an optically non-linear mixing material.

121. The three-dimensional display of Claim 6 or Claim 120, wherein each of said plurality of non-linear mixer elements further includes a lens for improving cones of acceptance of said optical mixer sub-elements.

122. The three-dimensional display of Claim 6 or Claim 121, wherein each of said plurality of non-linear mixer elements has a desired wavelength filter.

123. The three-dimensional display of Claim 6 or Claim 121, wherein each said plurality of non-linear mixer elements has a diffuser for improving the viewing angle of said optical mixer.

124. The three-dimensional display of Claim 123, wherein said lens is hemispherical, square, rectangular, trapezoidal, triangular, polyhedral, or circular in cross-section.

125. The three-dimensional display of Claim 122, wherein each of said plurality of non-linear mixing elements has an optical reflector positioned adjacent to said lens.

126. The three-dimensional display of Claim 125, wherein at least one of said at least three pulsed optical sources is located on the same side of the optical mixer as a viewer of the display.

127. The three dimensional display of Claim 121, wherein said non-linear mixer material is square, rectangular, trapezoidal, triangular, polyhedral, or circular in cross-section.

128. The three dimensional display of Claim 122, wherein said wavelength filter is square, rectangular, trapezoidal, triangular, polyhedral, or circular in cross-section.

129. The apparatus of Claim 76, wherein said intersecting locations are labeled with bar codes.

130. The apparatus of Claim 76, wherein said intersecting locations are labeled with numerals and bar codes.

131. An apparatus for capturing three-dimensional images, comprising:

at least one two-dimensional optical recorder;

at least one holographic calibration plate having a common holographic calibration pattern, said at least one holographic calibration plate being placed between a desired object and said at least one two-dimensional optical recorder; and

a light source of at least one calibration wavelength for illuminating said at least one holographic calibration plate so as to project a virtual calibration pattern into a field of view of said at least one two-dimensional optical and proximal to the desired object.

132. The apparatus of Claim 131, wherein the desired object is at least partially surrounded by a continuous holographic correction plate.

133. The apparatus of Claim 131, wherein at least one two-dimensional optical recorder moves to various positions to capture a plurality of images of the desired object.

134. The apparatus of Claim 131, wherein said optical recorder is capable of separating desired and calibration wavelengths.

135. The three-dimensional display of Claim 6, wherein said plurality of non-linear mixer elements are non-contiguous, discrete elements arranged on a surface such that any element in any voxel of the display is capable of optical excitation by a combination of said at least three pulsed optical sources to produce said at least one pre-determined wavelength.

136. The three-dimensional display of Claim 5, further comprising a pulse controller for controlling said at least three optical pulse sources, wherein independent attenuation in said pulse controller is provided by a spatial light modulator.

137. The three-dimensional display of Claim 118, wherein said desired optical wavelength corresponds to a primary color.

138. The three-dimensional display of Claim 137, wherein said primary color is one of red, blue and green.

139. The three-dimensional display of claim 117, wherein said sub-elements are spaced to minimize unintended excitation of sub-elements adjacent to a sub element which is being excited by overlapping pulses.

140. The method of claims 49, 50, or 51, wherein at least one laser ranging device illuminates and measures distances to points on the desired object using least one calibration wavelength.

141. The apparatus of claim 68, wherein said at least two optical recorders are a combination of two-dimensional and three-dimensional optical recorders.

142. The apparatus of any of Claims 104, 105, 106, or 107, wherein the selected calibration intervals provide synchronization of the optical recorders and other camera-related functions, and wherein the optical recorders capture a calibration wavelength during selected frames and captures only a desired wavelength during non-selected frames.

143. An apparatus for calibrating a multi-dimensional optical recorder, comprising:

a holographic calibration plate having a common holographic calibration pattern, said holographic calibration plate being placed between a desired object and the multi-dimensional optical recorder; and

a light source of at least one calibration wavelength for illuminating said holographic calibration plate so as to project a virtual calibration pattern into the field of view of the optical recorder and proximal to the desired object.

144. The apparatus of claim 143, wherein said light source is pulsed to provide time code for use by multiple three-dimensional imaging systems.

145. The apparatus of claim 143, wherein said light source is pulsed to provide synchronization to multiple three-dimensional imaging systems.

146. The apparatus of claim 143, wherein said light source is pulsed to provide time code and synchronization to multiple three-dimensional imaging systems.

147. A method for determining spatial positions of imperfections in diamonds, comprising the steps of:

illuminating a calibration hologram with one of a plurality of calibration wavelengths so as to project one of a plurality of three-dimensional calibration grids into a field of view of a stereographic microscope;

selecting one of said plurality of calibration wavelengths that yields a grid intersection point of said one of a plurality of three-

dimensional calibration grids nearest to the diamond imperfection; and,

calculating a position of said diamond imperfection using next nearest intersections of said one of a plurality of three-dimensional calibration grids generated by said selected calibration wavelength.

148. A method for counting biological specimens under a stereoscopic microscope, comprising the steps of:

illuminating a calibration hologram with one of a plurality of calibration wavelengths so as to project one of a plurality of three-dimensional calibration grids into a field of view of the stereographic microscope;

selecting one of said plurality of calibration wavelengths that yields a grid intersection point of said one of a plurality of three-dimensional calibration grids nearest a specimen to be counted;

calculating the position corresponding to said specimen using next nearest intersections of said one of a plurality of three-dimensional calibration grids generated by said selected calibration wavelength; and

counting specimens whose positions are known relative to the selected three-dimensional calibration grid.

149. The method of Claim 147 or 148, wherein the next nearest intersections are independently chosen from said plurality of three-dimensional calibration grids.

150. The method of Claim 147 or 148, wherein one calibration wavelength is used to record a three-dimensional calibration grid.

151. The method of Claim 150, wherein a second calibration wavelength is used to identify the intersections of the plurality of three-dimensional calibration grids with numerals.

152. The method of Claim 150, wherein a second calibration wavelength is used to identify the intersections of the plurality of three-dimensional calibration grids with bar codes.

153. The method of Claim 150, wherein a second calibration wavelength is used to identify the intersections of the plurality of three-dimensional calibration grids with numerals and bar codes.

154. A method for combining images from a plurality of optical recorders optimized for capturing different wavebands reflected from the desired object, wherein each optical recorder is capable of recording holographic calibration pattern wavelengths, comprising the steps of:

illuminating a calibration hologram with one of a plurality of calibration wavelengths so as to project one of a plurality of three-dimensional holographic calibration patterns into the field of view of each optical recorder; and

utilizing spatial orientations and positions of each optical recorder as determined by an orientation of each optical recorder relative to the calibration hologram for combining images for each optical recorder.

155. The method of Claim 154, wherein the plurality of optical recorders identify individuals using biometric information including fingerprint, hand geometry and vein structure.

156. The three-dimensional display of any of Claims 120, 121, 122, or 123, wherein the shape, cross-sectional area and the thickness for said lens, said non-linear mixing material, said wavelength filter and said diffuser compensate for conversion efficiency variations, power output variations, losses, and attenuation in the display system.

157. The three-dimensional display of Claim 16, wherein equalization of the intensities of the desired wavelengths in a voxel is controlled by adjusting peak power levels and pulse widths of said at least three optical sources.

158. A method for combining images from multiple optical recorders in an aircraft, comprising the steps of:

incorporating a set of calibration holograms into an optical window separating the inside from the outside of the aircraft;

placing multiple optical recorders inside the aircraft which are capable of capturing desired images through the optical window of objects outside the aircraft;

determining spatial orientations and positions of the multiple optical recorders;

illuminating the set of calibration holograms in the optical window via a holographic calibration plate with a calibration wavelength to produce a calibration pattern by which the spatial orientation and position of the multiple optical recorders is determined relative to the calibration pattern; and

utilizing the spatial orientations and positions to combine images from each optical recorder.

159. The method of Claim 158, wherein the calibration wavelengths is a wavelength used in collision avoidance systems.

160. The apparatus of any of Claims 64, 131, 143, or 158, wherein said holographic calibration plate is a variable plate hologram wherein external inputs phase modulate the holographic calibration plate.